

## **CHAPTER 4**

### **ENVIRONMENTAL CONSEQUENCES**

This chapter describes the impacts that would result from implementing the waste management alternatives described in Chapter 2. As an aid to the reader, this chapter begins with a guide to understanding the human health and transportation analyses (Section 4.1), followed by a summary of the impacts of the alternatives (Section 4.2).

The three alternatives and the sections in which they are fully discussed are:

- No Action Alternative – Continuation of Ongoing Waste Management Activities (Section 4.3);
- Alternative A – Offsite Shipment of HLW, LLW, Mixed LLW, and TRU Waste to Disposal and Ongoing Management of the Waste Storage Tanks – Preferred Alternative (Section 4.4); and
- Alternative B – Offsite Shipment of LLW and Mixed LLW to Disposal, Shipment of HLW and TRU Waste to Interim Storage, and Interim Stabilization of the Waste Storage Tanks (Section 4.5).

The potential for minority and low-income populations to bear a disproportionate share of high and adverse impacts from the proposed activities is discussed in Section 4.6.

The analyses in this chapter are limited to human health and transportation impacts. None of the proposed alternatives would require changes in the workforce or additional facilities at the WVDP premises; therefore, they would not affect the surrounding natural and cultural environments.

Additional information regarding the methodology used to conduct the analyses is contained in Appendices C and D.

As characterized in Chapter 2, the waste management activities assessed in this EIS would occur in the following facilities at the WVDP site: the Process Building; the Tank Farm; the LSB; LSAs 1, 3, and 4; the Chemical Process Cell Waste Storage Area; and the Radwaste Treatment System Drum Cell. This EIS evaluates proposed activities necessary to (1) store or prepare wastes for shipping, including loading containerized wastes onto transportation vehicles; (2) ship wastes to offsite disposal or interim storage; and (3) manage the emptied waste storage tanks until final decommissioning or long-term stewardship decisions can be made in the future.

The waste management actions proposed under all alternatives would be conducted in existing facilities (or in the case of waste transportation, on existing road and rail lines) by the existing work force and would not involve new construction or building demolition. Ongoing facility operations would continue, unaffected by the proposed actions assessed in this EIS. As a result, the scope of potential impacts that could result from the proposed actions is limited. Specifically, because there would be no mechanism for new land disturbance under any alternative, there would be no potential to directly or indirectly impact current land use; biotic communities; cultural, historical, or archaeological resources; visual resources; ambient noise levels; threatened or endangered species or their critical habitats; wetlands; or floodplains. Additionally, because the work force requirements would be the same under all alternatives (for example, there would be no increases or decreases from current employment levels), there would be no potential for socioeconomic impacts. Therefore, these elements of the affected environment would not be impacted by any actions proposed under the three alternatives and will not be discussed further in this chapter.

None of the onsite management activities under any of the alternatives would result in any new criteria air pollutant emissions (nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter). As shown in Section 3.3.2, the ambient air quality in the region of the Center complies with federal and state ambient air quality standards. Impacts of criteria air pollutant emissions resulting from transportation activities are incorporated in the transportation analysis. Radioactive emissions that could result from ongoing management or interim stabilization of the waste storage tanks are addressed under the human health analysis. Therefore, this chapter includes no further discussion of air quality impacts.

Consistent with DOE and Council on Environmental Quality NEPA guidance, the analysis of impacts in the following sections focuses on those limited areas in which impacts may occur from any action proposed by the three alternatives assessed in this EIS. Because of the limited scope of the proposed actions, there would be potential for impacts to only the workers and the public from the proposed onsite waste management actions, ongoing operations, and the offsite shipping of wastes.

## 4.1 UNDERSTANDING THE ANALYSIS

This section describes how impacts to worker and public human health from onsite waste management and offsite shipping were analyzed. This discussion is intended to help the reader understand the impacts described for each alternative in subsequent sections.

### 4.1.1 Human Health Impacts

#### 4.1.1.1 Routine Operations

The waste management activities that would be undertaken under each of the three alternatives analyzed would result in the exposure of workers to radiation and exposure of the public to very small quantities of radioactive materials from controlled releases to the environment. Radiation can cause a variety of ill-health effects in people, including cancer.

To determine whether health effects could occur as a result of radiation exposure from a particular activity and the extent of such effects, the radiation dose must be calculated. An individual may be exposed to radiation externally, through a radiation source outside of the body, and/or internally from ingesting or inhaling radioactive material. The dose is a function of the exposure pathway (for example, external exposure, inhalation, or ingestion) and the type and quantity of radionuclides involved.

The unit of radiation dose for an individual is the rem. A millirem (mrem) is 1/1,000 of a rem. The unit of dose for a population is person-rem and is determined by summing the individual doses of an exposed population. Dividing the person-rem estimate by the number of people in the population indicates the average dose that a single individual could receive. The impacts from a small dose to a large number of people can be approximated by the use of population (collective) dose estimates.

After the dose is estimated, the health impact is calculated from current internationally recognized risk factors. The

#### ***Exposure Standards***

The following radiation protection standards were established by the EPA and DOE.

- *EPA: 10-mrem radiation dose per year to the maximally exposed individual member of the public from airborne releases (40 CFR Part 61, Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities)*
- *DOE: 100-mrem dose per year to the maximally exposed individual member of the public through all exposure pathways (DOE Order 5400.5, Radiation Protection of the Public and the Environment)*
- *DOE: 5-rem dose per year for workers (10 CFR 835, Occupational Radiation Protection)*

potential health impact is stated in terms of the probability of a latent cancer fatality (a fatality resulting from a cancer that was originally induced by radiation but which may occur years after the exposure) to an individual or the number of latent cancer fatalities expected in a population.

To estimate the human health impact from radiation dose, a dose-to-risk factor that indicates the potential for a latent cancer fatality is used. The dose-to-risk factor for low (less than 20 rem) annual doses is  $5 \times 10^{-4}$  of a latent cancer fatality per person-rem for the general public, which includes the very young and the very old, and  $4 \times 10^{-4}$  for the worker population (ICRP 1991). For example, a population dose of 2,000 person-rem is estimated to result in 1 additional cancer fatality ( $0.0005 \times 2,000 = 1$ ) in the general public.

Calculations of the number of latent cancer fatalities associated with radiation doses often do not yield whole numbers, and the number may be less than 1. For example, if a population of 1,000,000 people each received a radiation dose of 1 mrem ( $1 \times 10^{-3}$  rem) per person, the population dose would be 1,000 person-rem. The number of latent cancer fatalities would be 0.5 (1,000,000 persons  $\times$  0.001 rem  $\times$  0.0005 latent cancer fatalities per person-rem = 0.5 latent cancer fatalities). The value of 0.5 is the average number of latent cancer fatalities that would occur if the same radiation dose were applied to many different groups of 1,000,000 people. Some groups would experience 1 latent cancer fatality from the radiation dose, some groups would experience no latent cancer fatalities from the radiation dose, and the average would be 0.5. In this context, the value of 0.5 is often referred to as the probability of a latent cancer fatality in the exposed population of 1,000,000 people.

For perspective, it is estimated that the average individual in the United States receives a dose of about 300 mrem (0.3 rem) each year from natural sources of radiation. The probability of a latent cancer fatality corresponding to a single individual's exposure over an assumed 72-year lifetime to 300 mrem annually is about 0.01 or about 1 in 100 (1 person  $\times$  300 mrem per year  $\times$  1 rem per 1,000 mrem  $\times$  72 years  $\times$  0.0005 latent cancer fatalities per person-rem = 0.01 latent cancer fatality). If 1,000,000 people were exposed to 300 mrem per year over a 72-year lifetime, about 10,000 latent cancer fatalities would be estimated to occur (1,000,000 people  $\times$  300 mrem/year  $\times$  72 years  $\times$   $5 \times 10^{-7}$  latent cancer fatalities/mrem = 11,000 latent cancer fatalities, rounded to 10,000 latent cancer fatalities).

Under all alternatives, people near the WVDP site would be exposed to radionuclides (radioactive atoms) that are released to the atmosphere and to surface water during normal ongoing operations at the site. For this EIS, DOE estimated the radiation doses from those releases using the GENII computer model (Napier et al. 1988). People were assumed to inhale radioactive material and to be exposed to external radiation from the radioactive material released during normal ongoing operations. People were also assumed to ingest radioactive material through foodstuffs such as leafy vegetables, produce, meat, and milk and to be exposed through activities such as swimming and boating; inadvertent soil ingestion; inhaling resuspended radioactive material; drinking water; and consuming fish from Lake Erie.

DOE analyzed the exposure of members of the public and workers to radiation or radioactive releases as a result of the alternatives. For workers, DOE analyzed the exposure of

#### ***Ongoing Operations***

Under all alternatives, it is assumed that current levels of maintenance, surveillance, heating, ventilation, and other routine operations would continue to be required while the actions proposed under each alternative were performed. For this EIS, these actions are called *ongoing operations*. Although the impacts of these ongoing actions have been assessed in several previous NEPA documents and are characterized in the Annual Site Environmental Reports, the impacts on worker and public health of these ongoing operations have been included in this EIS using actual operational data from 1995 through 1999. Because ongoing operations would not vary among the proposed alternatives, the impacts from these actions would be the same across all alternatives.

both involved and noninvolved workers at the site. Involved workers are those who would be undertaking the proposed waste management activities analyzed in this EIS. They would be exposed to radioactive releases from both the waste management activities and the ongoing operations of the site. Noninvolved workers are those workers who would be present on the site but who would not be conducting the proposed waste management activities. These workers would be conducting activities related to the ongoing operations of the WVDP site. Doses to the worker populations and to individual workers were estimated.

For the public, dose estimates were derived for both the maximally exposed individual (a member of the public located nearest to the site) and the collective population within 80 kilometers (50 miles) of the site.

For both the public and workers, DOE then calculated the probability that the maximally exposed individual would suffer a latent cancer fatality if exposed to that radiation dose and the probability that a latent cancer fatality would occur within the exposed population.

Additional information regarding the analysis of human health impacts under routine operations can be found in Appendix C.

#### **4.1.1.2 Accident Conditions**

For this EIS, DOE evaluated a wide range of potential facility accidents at the WVDP site that could result from handling mishaps, fires, or spills, or from external events such as high winds or earthquakes. Although a great many accidents could occur at WVDP facilities, only a few accidents could potentially result in an uncontrolled release of radioactive material to the environment.

Of the accidents that were evaluated, DOE selected 14 accidents for further evaluation using the GENII computer model (Napier et al. 1988). These accidents were selected because they could result from operations and activities that were determined to present the greatest risk, based on their accident consequence and probability.

The chance that an accident might occur during the conduct of an activity is called the probability of occurrence. An event that is certain to occur has a probability of 1 (as in 100 percent certainty). The probability of occurrence of an accident is less than 1 because accidents, by definition, are not certain to occur. However, in its accident analysis, when calculating the probability of a latent cancer fatality occurring as a result of exposure to radiation in particular accident situations, DOE did not take into account the probability of occurrence of the accident.

In an accident, radioactive material could be released from ground level or from a stack. Atmospheric conditions at the time of an accident would affect the dose received by workers, the maximally exposed individual, and the public. For that reason, DOE used two types of atmospheric conditions to estimate radiation doses: (1) atmospheric conditions that are not exceeded 50 percent of the time and provide a realistic estimate of the likely atmospheric conditions that would exist during an accident (50-percent atmospheric conditions), and (2) atmospheric conditions that are not exceeded 95 percent of the time and

#### ***Human Health Impacts***

DOE estimated radiation doses to:

- Involved workers
  - Worker population
  - Individual workers
- Noninvolved workers
  - Worker population
  - Individual workers
- Members of the public
  - Collective population
  - Maximally exposed individual

Using accepted dose-to-risk conversion factors, DOE calculated the probability that an individual would suffer a latent cancer fatality or that a latent cancer fatality would occur within the exposed population.

provide an upper bound on the atmospheric conditions that would exist during an accident (95-percent atmospheric conditions). Site-specific meteorological data from 1994 through 1998 (WVNS 2000a) were used to determine 50-percent and 95-percent atmospheric conditions.

After estimating the radiation that could be released as a result of specific postulated accidents at the WVDP site (the dose to workers or the public), DOE estimated the probability of latent cancer fatalities if those accidents were to occur. As with routine operations, DOE provides the probability of latent cancer fatalities under accident conditions for workers and members of the public (the maximally exposed individual and the collective population within 80 kilometers [50 miles] of the site).

Additional information regarding the analysis of human health impacts under accident conditions can be found in Appendix C.

#### **4.1.2 Transportation Impacts**

DOE analyzed the potential impacts of shipping radioactive waste from the WVDP site to a storage or disposal site under both incident-free and accident conditions. Representative highway and rail routes from the WVDP site to specific destinations were determined using the WebTRAGIS routing computer code (Johnson and Michelhaugh 2000). The routes conform to current routing practices and applicable routing regulations and guidelines. The populations that might be exposed along these routes were determined using data from the 2000 census.

The total impacts of transportation are the sums of the radiological and nonradiological incident-free and accident impacts. For incident-free transportation, the potential human health impacts were estimated for transportation workers and populations along the route, people sharing the route (in traffic), and people at stops along the route. The impacts from incident-free transportation are the radiological impacts from exposure to low levels of radiation from the radioactive waste containers and the nonradiological impacts from truck or train exhaust. The RADTRAN 5 computer code (Neuhauser et al. 2000) was used to estimate the impacts for transportation workers and populations. Impacts were also estimated for the maximally exposed individual, who may be a worker or a member of the public, using the RISKIND computer code (Yuan et al. 1995). The impacts for the maximally exposed individual are presented separately from the other incident-free transportation impacts.

Human health impacts could result from transportation accidents in which radioactive material could be released from a waste container and from traffic accidents in which no radioactive material would be released. For transportation accidents involving a release of radioactive material, DOE estimated radiological accident risks (probability of occurrence  $\times$  consequence) expressed as the number of latent cancer fatalities summed over a complete spectrum of accidents. Impacts were evaluated for the population within 80 kilometers (50 miles) of the road or railway using the RADTRAN 5 computer code. DOE assumed that people would be exposed through inhalation, direct external dose from radioactive material that has deposited on the ground after being dispersed from the accident site (referred to as groundshine), and direct external dose from the passing cloud of dispersed radioactive material (referred to as cloudshine). In rural areas, DOE assumed that exposure could also occur through ingestion of agricultural products grown in contaminated soil. Consequences were also estimated for a severe transportation accident, known as the maximum reasonably foreseeable accident. These consequences were estimated using the RISKIND computer code and are presented separately from the other transportation accident impacts.

Additional information regarding the analysis of transportation impacts under both incident-free and accident conditions can be found in Appendix D.

## **4.2 SUMMARY OF IMPACTS**

The actions proposed by the alternatives analyzed in this EIS would have an almost imperceptible impact on the health of the workers and the public, even when combined with the minimal impacts of ongoing operations. Health impacts for all alternatives under normal onsite operating conditions and offsite transportation would result in less than 1 cancer fatality among workers or the public.

### **4.2.1 Human Health Impacts**

Waste management activities under each alternative would result in the exposure of workers to radiation and contaminated material and exposure of the public to very small quantities of radioactive materials. Because the proposed waste management actions would involve only the storage, packaging, loading, and shipping of wastes and management options for the waste storage tanks, the proposed activities would result in a statistically insignificant contribution to the historically low impacts of ongoing WVDP operations. As a result, the human health impacts to involved and noninvolved workers and the public are dominated by ongoing WVDP site operations that would continue under all alternatives; therefore, there would be little discernible difference in the impacts that could occur among the three alternatives. The potential human health impacts for onsite waste management actions are summarized below and demonstrate that the impacts of each alternative would result in less than 1 cancer fatality among workers or the public under normal operating conditions.

- Total Involved and Noninvolved Worker Population Dose (in person-rem)
  - No Action Alternative 150
  - Alternative A 210
  - Alternative B 210
- Latent Cancer Fatalities in Involved and Noninvolved Worker Population
  - No Action Alternative less than 1 (0.062)
  - Alternative A less than 1 (0.084)
  - Alternative B less than 1 (0.085)
- Total Public Population Dose (in person-rem)
  - No Action Alternative 2.5
  - Alternative A 2.5
  - Alternative B 2.5
- Latent Cancer Fatalities in Public Population
  - No Action Alternative less than 1 ( $1.3 \times 10^{-3}$ )
  - Alternative A less than 1 ( $1.3 \times 10^{-3}$ )
  - Alternative B less than 1 ( $1.3 \times 10^{-3}$ )
- Total Maximally Exposed Individual Dose (in mrem)
  - No Action Alternative 0.62
  - Alternative A 0.62
  - Alternative B 0.62
- Total Probability of Latent Cancer Fatality to Maximally Exposed Individual
  - No Action Alternative  $3.1 \times 10^{-7}$
  - Alternative A  $3.1 \times 10^{-7}$
  - Alternative B  $3.1 \times 10^{-7}$

Based on the detailed analyses provided later in this chapter and in Appendix C, under all alternatives, neither individual involved workers, the maximally exposed individual, nor the general public near the WVDP site would be expected to incur a latent cancer fatality under any atmospheric conditions if an accident were to occur during waste management activities. Among the accident scenarios evaluated, the projected latent cancer fatalities among the public ranged from a high of 0.070 to a low of  $3.8 \times 10^{-6}$ . The frequencies of these accidents ranged from 0.1 to  $10^{-8}$  per year. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for these accidents was less than 1. Therefore, the radioactive releases from these accidents would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### **4.2.2 Transportation Impacts**

Projected impacts from offsite waste transportation were less than 1 latent cancer fatality among workers and the public for all three alternatives. Rail transportation was generally found to be slightly higher than, but similar to, the impacts from truck transportation. Impacts are also projected to be slightly higher for Alternative B due to the increased shipping required to move the TRU and HLW wastes to interim storage prior to ultimate disposal. Although the same number of shipments would be loaded at the WVDP site (2,250 truck or 847 rail), the total number of shipments required to reach disposal destinations would be higher under Alternative B due to the interim storage of TRU waste and HLW (see Table 2-3).

The transportation impacts that could result from transportation are summarized below.

- No Action Alternative
  - 169 truck or 85 rail shipments of Class A LLW
  - 0.030 – 0.037 fatalities expected from truck shipments
  - 0.036 – 0.043 fatalities expected from rail shipments
- Alternative A
  - 2,550 truck or 847 rail shipments of LLW, mixed LLW, TRU waste and HLW canisters
  - 0.69 – 0.72 fatality expected for truck shipments
  - 0.52 – 0.59 fatalities expected for rail shipments
- Alternative B
  - 3,120 truck or 1,079 rail shipments of LLW, mixed LLW, TRU waste, and HLW canisters
  - 0.76 – 0.87 fatality expected for truck shipments;
  - 0.62 – 0.78 fatalities expected for rail shipments

The consequences of the maximum reasonably foreseeable transportation accidents under each alternative would vary slightly among the alternatives and between truck and rail transport. Under the No Action Alternative, the maximum reasonably foreseeable transportation accident would involve Class A LLW. For truck transport, this accident could result in about 1 latent cancer fatality, and for rail about 1 latent cancer fatality, among the exposed population. For Alternatives A and B, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Because one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident would be the same. Among the exposed population, this accident could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for the Class A LLW accidents and the CH-TRU accident was less than 1. Therefore, the radioactive releases from the Class A LLW accidents and the

CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

### 4.2.3 Offsite Impacts

Impacts of waste management activities at offsite locations (Envirocare, Hanford, INEEL, NTS, ORNL, SRS, WIPP, and Yucca Mountain) have been addressed in earlier NEPA documents (see Section 1.7.1). For all waste types, WVDP waste represents less than 2 percent of the total DOE waste inventory. Human health impacts at all sites as a result of the management (storage or disposal) of WVDP during the 10-year period of analysis would be very minor (substantially less than 1 latent cancer fatality).

## 4.3 IMPACTS OF THE NO ACTION ALTERNATIVE – CONTINUATION OF ONGOING WASTE MANAGEMENT ACTIVITIES

As described in Chapter 2, under the **No Action Alternative**, no additional waste management activities would be performed beyond those activities that have already been evaluated under prior NEPA analyses (Section 1.7.1) in accordance with the provisions of the Council on Environmental Quality Implementing Regulations for NEPA (40 CFR Parts 1500-1508). DOE would provide continued operational support and monitoring of the facilities to meet the requirements for safety and hazard management. Waste management activities currently in progress for onsite storage of existing wastes and offsite disposition of a limited quantity of Class A LLW to a facility such as Envirocare (a commercial radioactive waste disposal site in Clive, Utah) or NTS in Mercury, Nevada, would continue. For the purposes of analysis, however, offsite disposal of Class A LLW at Hanford was also considered. The emptied waste storage tanks would continue to be ventilated and maintained in either a wet or dry condition to mitigate corrosion until final decisions are reached in a ROD for the Decommissioning and/or Long-Term Stewardship EIS. Both wet and dry conditions were analyzed in this EIS. Under the No Action Alternative, active hazard management, operational support, surveillance, and oversight would continue at the current levels of activity. The waste management activities evaluated under this alternative would occur over the next 10 years.

### 4.3.1 Human Health Impacts (No Action Alternative)

This section characterizes the radiological impacts from the No Action Alternative activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material from controlled releases to the environment. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services. The figures shown in the textbox provide the relative probabilities of cancer fatalities from more common sources of risk.

#### *Comparative Risk*

##### Cause of Death

Cancer	1 chance in 5
Lung cancer due to smoking	1 chance in 10
Cancer caused by background radiation	1 chance in 100
Second-hand smoke	1 chance in 700
Motor vehicle accident	1 chance in 5,000
Cancer due to CAT scan	1 chance in 20,000
Cancer due to chest x-ray	1 chance in 250,000

##### Approximate Probability

**Worker Impacts.** Under the No Action Alternative, waste management activities currently in progress would continue for onsite storage of existing wastes and offsite disposal of a limited quantity of Class A LLW. Management of the waste storage tanks would also continue as under current operations. Table 4-1 presents the radiological impacts to involved and noninvolved workers for the No Action Alternative. During the 10-year time period, the collective radiation dose to involved workers was



**Table 4-1. Radiation Doses for Involved and Noninvolved Workers  
Under the No Action Alternative**

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers <sup>a</sup>	No Action Alternative activities	10	0.41	4.1	$1.6 \times 10^{-4}$	$1.6 \times 10^{-3}$
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	15	150	$6.0 \times 10^{-3}$	$6.0 \times 10^{-2}$
All workers	Total	10	15	150	$6.2 \times 10^{-3}$	$6.2 \times 10^{-2}$
Worker Population	Activity	Time Period (years)	Individual Dose		Latent Cancer Fatalities	
			Annual (mrem/yr)	Total (mrem)	Annual	Total
Involved workers <sup>a</sup>	No Action Alternative activities	10	68	680	$2.7 \times 10^{-5}$	$2.7 \times 10^{-4}$
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	59	590	$2.4 \times 10^{-5}$	$2.4 \times 10^{-4}$

a. Involved workers would be those individuals that actively participate in the No Action Alternative.

b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in the No Action Alternative.

estimated to be about 4.1 person-rem or about 0.41 person-rem per year from activities under the No Action Alternative. Over this same time period, the individual radiation dose to the average involved worker would be about 68 mrem per year.

This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 ( $2.7 \times 10^{-5}$ ) latent cancer fatality or a chance of about 1 in 37,000 per year.

In addition to radiation doses from No Action Alternative activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both No Action Alternative activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 150 person-rem over the duration of the No Action Alternative or about 15 person-rem per year (Table 4-1). This dose is equivalent to less than 1 (0.062) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under the No Action Alternative, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

**Public Impacts.** Under the No Action Alternative, waste management activities currently in progress would continue for onsite storage of existing wastes and offsite disposal of a limited quantity of Class A LLW. Management of the waste storage tanks would also continue as under current operations. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP (Table 4-2).

**Table 4-2. Radiation Doses to the Public Under the No Action Alternative<sup>a</sup>**

Activity	Maximally Exposed Individual				Population Around WVDP Site			
	Individual Radiation Dose <sup>b</sup>		Probability of Latent Cancer Fatality		Collective Radiation Dose <sup>c</sup>		Probability of Latent Cancer Fatality	
	Annual (mrem/yr)	Total (mrem)			Annual (person-rem/yr)	Total (person-rem)		
			Annual	Total			Annual	Total
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	$1.1 \times 10^{-8}$	$1.1 \times 10^{-7}$	0.17	1.7	$8.5 \times 10^{-5}$	$8.5 \times 10^{-4}$
Percent of EPA standard (10 mrem per year)	<1	NA <sup>d</sup>	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	$2.1 \times 10^{-8}$	$2.1 \times 10^{-7}$	0.083	0.83	$4.2 \times 10^{-5}$	$4.2 \times 10^{-4}$
All pathways	0.062	0.62	$3.1 \times 10^{-8}$	$3.1 \times 10^{-7}$	0.25	2.5	$1.3 \times 10^{-4}$	$1.3 \times 10^{-3}$
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for the No Action Alternative is 10 years.

b. Individual background radiation doses are about 300 mrem per year.

c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.

d. NA = not applicable.

**Annual Dose.** The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 ( $1.3 \times 10^{-4}$ ) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*) and would result in less than 1 ( $3.1 \times 10^{-8}$ ) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

**Total Dose.** For the duration of the No Action Alternative (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 ( $1.3 \times 10^{-3}$ ) latent cancer fatality over the duration of the No Action Alternative.

#### 4.3.2 Impacts from Facility Accidents (No Action Alternative)

DOE evaluated the potential impacts that could occur as a result of accidents at the WVDP site during the implementation of the No Action Alternative. Because only Class A LLW would be shipped under the No Action Alternative, these accidents were limited to those involving the handling of Class A LLW in preparation for shipping. In addition, accidents involving the ongoing management of Tanks 8D-1 and 8D-2 were evaluated. Accidents involving ongoing or continuing activities at the WVDP site that were

not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

One potential handling accident involved the puncture of a drum containing Class A LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of  $7.1 \times 10^{-6}$  rem. This accident could result in a radiation dose of  $2.4 \times 10^{-6}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.0075 person-rem; this is equivalent to a probability of a latent cancer fatality of  $3.8 \times 10^{-6}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $6.0 \times 10^{-5}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

A second potential accident involved a drop of a pallet containing six Class A LLW drums, all of which were assumed to rupture. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of  $4.2 \times 10^{-5}$  rem. This accident could result in a radiation dose of  $1.4 \times 10^{-5}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.044 person-rem; this is equivalent to a probability of a latent cancer fatality of  $2.2 \times 10^{-5}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $3.5 \times 10^{-4}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

A third potential accident involved the puncture of a box containing Class A LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of  $8.5 \times 10^{-5}$  rem. This accident could result in a radiation dose of  $2.9 \times 10^{-5}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.090 person-rem; this is equivalent to a probability of a latent cancer fatality of  $4.5 \times 10^{-5}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $7.0 \times 10^{-4}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

DOE also analyzed accidents involving the ongoing management of Tanks 8D-1 and 8D-2. These accidents assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. Two accidents were analyzed, one where the contents of the tank were kept wet and another where the contents of the tank were allowed to dry before the collapse. The frequencies of the accidents were estimated to be in the range of  $10^{-4}$  to  $10^{-6}$  per year.

The consequences of the accidents using 50-percent atmospheric conditions are presented in Table 4-3. If the contents of the tanks are kept wet, the accident could result in a radiation dose of  $2.4 \times 10^{-3}$  rem for the worker located at the site. This accident could result in a radiation dose of  $8.1 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 2.5 person-rem; this is equivalent to

**Table 4-3. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Class A drum puncture <sup>b</sup>	0.1 – 0.01	$7.1 \times 10^{-6}$	$2.8 \times 10^{-9}$	$2.4 \times 10^{-6}$	$1.2 \times 10^{-9}$	$7.5 \times 10^{-3}$	$3.8 \times 10^{-6}$
Class A pallet drop <sup>b</sup>	0.1 – 0.01	$4.2 \times 10^{-5}$	$1.7 \times 10^{-8}$	$1.4 \times 10^{-5}$	$7.0 \times 10^{-9}$	0.044	$2.2 \times 10^{-5}$
Class A box puncture <sup>b</sup>	0.1 – 0.01	$8.5 \times 10^{-5}$	$3.4 \times 10^{-8}$	$2.9 \times 10^{-5}$	$1.5 \times 10^{-8}$	0.090	$4.5 \times 10^{-5}$
Collapse of Tank 8D-2 (wet) <sup>b</sup>	$10^{-4} - 10^{-6}$	$2.4 \times 10^{-3}$	$9.6 \times 10^{-7}$	$8.1 \times 10^{-4}$	$4.1 \times 10^{-7}$	2.5	$1.3 \times 10^{-3}$
Collapse of Tank 8D-2 (dry) <sup>b</sup>	$10^{-4} - 10^{-6}$	$2.8 \times 10^{-3}$	$1.1 \times 10^{-6}$	$9.5 \times 10^{-4}$	$4.8 \times 10^{-7}$	3.0	$1.5 \times 10^{-3}$

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

**Table 4-4. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Class A drum puncture <sup>b</sup>	0.1 – 0.01	$7.0 \times 10^{-5}$	$2.8 \times 10^{-8}$	$2.6 \times 10^{-5}$	$1.3 \times 10^{-8}$	0.12	$6.0 \times 10^{-5}$
Class A pallet drop <sup>b</sup>	0.1 – 0.01	$4.2 \times 10^{-4}$	$1.7 \times 10^{-7}$	$1.5 \times 10^{-4}$	$7.5 \times 10^{-8}$	0.69	$3.5 \times 10^{-4}$
Class A box puncture <sup>b</sup>	0.1 – 0.01	$8.4 \times 10^{-4}$	$3.4 \times 10^{-7}$	$3.2 \times 10^{-4}$	$1.6 \times 10^{-7}$	1.4	$7.0 \times 10^{-4}$
Collapse of Tank 8D-2 (wet) <sup>b</sup>	$10^{-4} - 10^{-6}$	0.024	$9.6 \times 10^{-6}$	$8.9 \times 10^{-3}$	$4.5 \times 10^{-6}$	39	0.020
Collapse of Tank 8D-2 (dry) <sup>b</sup>	$10^{-4} - 10^{-6}$	0.028	$1.1 \times 10^{-5}$	0.010	$5.0 \times 10^{-6}$	46	0.023

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

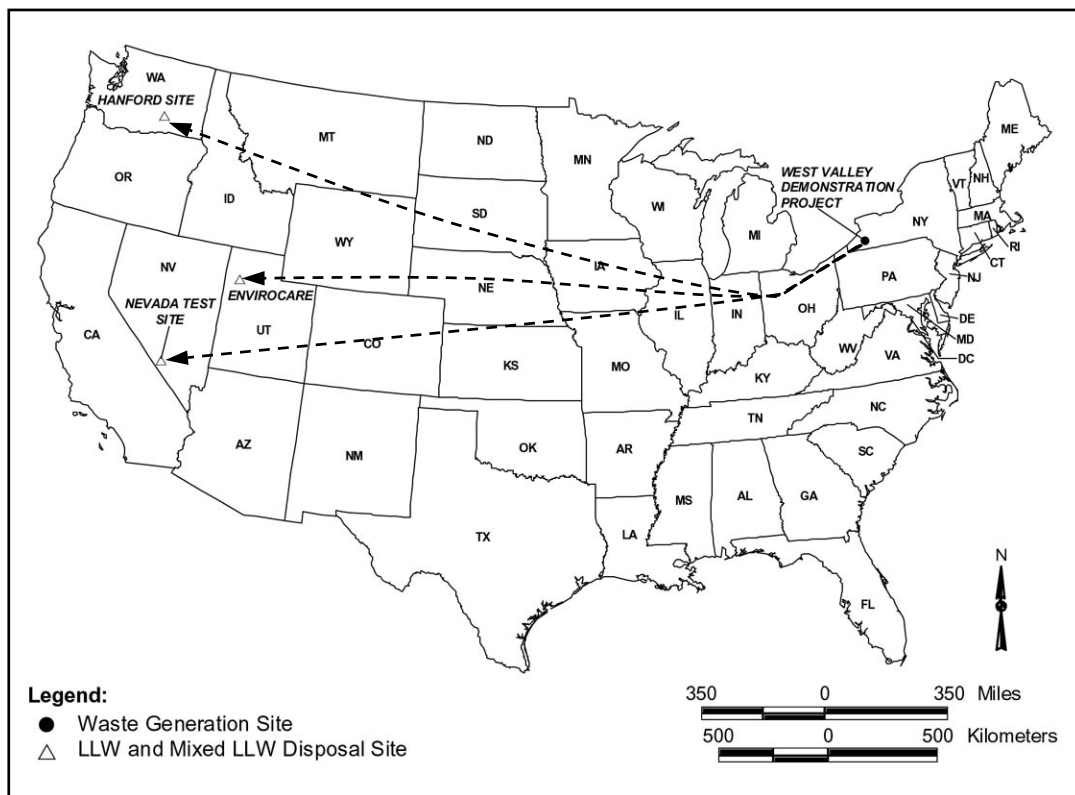
a probability of a latent cancer fatality of  $1.3 \times 10^{-3}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.020 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

If the contents of the tanks are kept dry, this accident could result in a radiation dose of  $2.8 \times 10^{-3}$  rem for the worker located at the site (Table 4-3). This accident could result in a radiation dose of  $9.5 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 3.0 person-rem; this is equivalent to a probability of a latent cancer fatality of  $1.5 \times 10^{-3}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.023 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

The highest consequence accident in Table 4-3 was the collapse of Tank 8D-2 while the contents of the tank were dry. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases for this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### 4.3.3 Transportation (No Action Alternative)

Under the No Action Alternative analysis, about 4,100 cubic meters (145,000 cubic feet) of Class A LLW would be shipped for disposal either to NTS, Hanford, or a commercial disposal site such as Envirocare, under existing NEPA reviews. These shipments would take place over 10 years. All other newly generated and existing wastes would continue to be stored under this alternative. The waste transportation destinations proposed under the No Action Alternative are shown in Figure 4-1.



**Figure 4-1. Waste Destinations Under the No Action Alternative**

Transportation impacts were estimated assuming 100 percent of the Class A LLW would be shipped by truck and 100 percent of the Class A LLW would be shipped by rail. Table 4-5 lists the Class A LLW shipments proposed under the No Action Alternative.

**Table 4-5. LLW Waste Shipped Under the No Action Alternative**

Waste Type	Container Type	Waste Shipped (cubic feet) <sup>a</sup>	Number of Containers	Number of Shipments
Class A LLW	Boxes <sup>b</sup>	97,649	1,206	87 (truck) 44 (rail)
	Drums <sup>b</sup>	47,351	6,878	82 (truck) 41 (rail)
Total		145,000	8,084	169 (truck) 85 (rail)

a. To convert cubic feet to cubic meters, multiply by 0.028

b. Shipped in Type A shipping container

#### 4.3.3.1 Total Impacts from Transportation Activities

The transportation impacts of shipping radioactive waste would be from two sources: incident-free transportation and transportation accidents. Both radiological impacts and nonradiological impacts are included in the analysis. The total impacts from transportation would be the sum of the impacts from incident-free transportation and transportation accidents. Additional details on these analyses are provided in Appendix D.

Table 4-6 lists the total transportation impacts by waste type and destination under the No Action Alternative. If either trucks or trains were used to ship the radioactive waste, less than 1 fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States over the 10-year time period for the No Action Alternative (U.S. Bureau of the Census 1997).

**Table 4-6. Transportation Impacts Under the No Action Alternative**

Waste Type	Destination	Incident-Free		Radiological Accident Risk (LCFs)	Pollution Health Effects (Fatalities)	Traffic Fatalities	Total Fatalities
		Public	Worker				
		(LCFs)					
Truck							
Class A LLW	Envirocare	$7.7 \times 10^{-3}$	$9.2 \times 10^{-3}$	$5.7 \times 10^{-5}$	$2.1 \times 10^{-3}$	$1.1 \times 10^{-2}$	$3.0 \times 10^{-2}$
	Hanford Site	$9.3 \times 10^{-3}$	$1.1 \times 10^{-2}$	$6.2 \times 10^{-5}$	$2.3 \times 10^{-3}$	$1.4 \times 10^{-2}$	$3.7 \times 10^{-2}$
	NTS	$9.5 \times 10^{-3}$	$1.1 \times 10^{-2}$	$7.1 \times 10^{-5}$	$2.8 \times 10^{-3}$	$1.3 \times 10^{-2}$	$3.6 \times 10^{-2}$
Total Truck Fatalities: 0.030 – 0.037							
Rail							
Class A LLW	Envirocare	$1.4 \times 10^{-2}$	$9.7 \times 10^{-3}$	$2.2 \times 10^{-4}$	$3.0 \times 10^{-3}$	$9.8 \times 10^{-3}$	$3.6 \times 10^{-2}$
	Hanford Site	$1.4 \times 10^{-2}$	$1.0 \times 10^{-2}$	$2.5 \times 10^{-4}$	$3.1 \times 10^{-3}$	$1.2 \times 10^{-2}$	$4.0 \times 10^{-2}$
	NTS	$1.4 \times 10^{-2}$	$1.3 \times 10^{-2}$	$2.3 \times 10^{-4}$	$3.0 \times 10^{-3}$	$1.2 \times 10^{-2}$	$4.3 \times 10^{-2}$
Total Rail Fatalities: 0.036 – 0.043							

Acronyms: LCFs = latent cancer fatalities; NTS = Nevada Test Site. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

#### 4.3.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

**Worker Impacts.** If trucks were used to ship the waste, the maximally exposed worker would be a driver who would receive a radiation dose of about 250 mrem per year based on driving a truck containing radioactive waste for about 700 hours per year. This is equivalent to a probability of a latent cancer fatality of about  $1.0 \times 10^{-4}$ . If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 1.9 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $7.6 \times 10^{-7}$ .

**Public Impacts.** For truck shipments, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 0.10 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $5.0 \times 10^{-8}$ .

If shipments were made by rail, the maximally exposed member of the public would be a railyard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 0.35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $1.8 \times 10^{-7}$ .

#### **4.3.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents**

The maximally exposed individual would receive a radiation dose of 4.6 rem from the maximum reasonably foreseeable transportation accident involving a truck shipment of Class A LLW. This is equivalent to a probability of a latent cancer fatality of about  $2.3 \times 10^{-3}$ . The probability of this accident is about  $5 \times 10^{-7}$  per year. The population would receive a collective radiation dose of about 1,300 person-rem from this truck accident involving Class A LLW. This could result in about 1 latent cancer fatality.

For the maximum reasonably foreseeable transportation rail accident involving Class A LLW, the maximally exposed individual would receive a radiation dose of about 9.2 rem. This is equivalent to a probability of a latent cancer fatality of about  $4.6 \times 10^{-3}$ . The probability of this accident is about  $2 \times 10^{-6}$  per year. The population would receive a collective radiation dose of about 2,600 person-rem from this rail accident involving Class A LLW. This could result in about 1 latent cancer fatality.

Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for the Class A LLW accidents was less than 1. Therefore, the radioactive releases from the Class A LLW accidents would not be likely to cause persistent, measurable deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### **4.3.4 Offsite Impacts (No Action Alternative)**

Under the No Action Alternative, 4,060 cubic meters (145,000 cubic feet) of Class A LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP Class A LLW were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from  $4.8 \times 10^{-3}$  to  $5.4 \times 10^{-3}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between  $6.9 \times 10^{-6}$  and  $3 \times 10^{-16}$ . Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C.10, explains how these impacts were derived.

#### **4.4 IMPACTS OF ALTERNATIVE A – OFFSITE SHIPMENT OF HLW, LLW, MIXED LLW, AND TRU WASTE TO DISPOSAL AND ONGOING MANAGEMENT OF THE WASTE STORAGE TANKS**

Under **Alternative A (Preferred Alternative)**, DOE would ship Class A, B, and C LLW and mixed LLW to one of two DOE potential disposal sites (in Washington or Nevada) or to a commercial disposal site (such as the Envirocare facility in Utah); ship TRU waste to WIPP in New Mexico; and ship HLW to the proposed Yucca Mountain HLW Repository. LLW and mixed LLW would be shipped over the next 10 years. TRU waste shipments to WIPP could occur within the next 10 years if the TRU waste were determined to meet all the requirements for disposal in this repository. If some or all of WVDP's TRU

waste did not meet these requirements, the Department would need to explore other alternatives for disposal of this waste.

Under DOE's current programmatic decisionmaking, offsite disposal of HLW would occur at the proposed Yucca Mountain HLW Repository sometime after 2025 assuming a license to operate is granted by NRC. Although this period would extend well beyond the 10 years required for all other proposed actions under this alternative, the impacts of transporting the HLW have been included in this EIS to fully inform the decisionmakers should an earlier opportunity to ship HLW present itself. The waste storage tanks would continue to be managed as described under the No Action Alternative.

#### 4.4.1 Human Health Impacts (Alternative A)

This section characterizes the radiological impacts from Alternative A activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services.

**Worker Impacts.** Under Alternative A, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. Management of the waste storage tanks would continue as under current operations. Table 4-7 presents the radiological impacts to involved and noninvolved workers for Alternative A. During the 10-year time period, the collective radiation dose to involved workers was estimated to be about 61 person-rem or about 6.1 person-rem per year from activities under Alternative A. Over this same time period, the individual radiation dose to the average involved worker would be about 260 mrem per year. This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 ( $1.0 \times 10^{-4}$ ) latent cancer fatality or a chance of about 1 in 10,000 per year.

**Table 4-7. Radiation Doses for Involved and Noninvolved Workers Under Alternative A**

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers <sup>a</sup>	Alternative A activities	10	6.1	61	$2.4 \times 10^{-3}$	0.024
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	15	150	$6.0 \times 10^{-3}$	0.06
All workers	Total	10	21	210	$8.4 \times 10^{-3}$	0.084
Worker Population	Activity	Time Period (years)	Individual Dose		Latent Cancer Fatalities	
			Annual (mrem/yr)	Total (mrem)	Annual	Total
Involved workers <sup>a</sup>	Alternative A activities	10	260	2,600	$1.0 \times 10^{-4}$	$1.0 \times 10^{-3}$
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	59	590	$2.4 \times 10^{-5}$	$2.4 \times 10^{-4}$

a. Involved workers would be those individuals that actively participate in Alternative A.

b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in Alternative A.



In addition to radiation doses from Alternative A activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both Alternative A activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 210 person-rem over the duration of Alternative A or about 21 person-rem per year (Table 4-7). This dose is equivalent to less than 1 (0.084) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under Alternative A, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

**Public Impacts.** Under Alternative A, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. Management of the waste storage tanks would also continue as under current operations. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP and thus would be the same as under the No Action Alternative (Table 4-8).

**Table 4-8. Radiation Doses to the Public Under Alternative A<sup>a</sup>**

Activity	Maximally Exposed Individual				Population Around WVDP Site			
	Individual Radiation Dose <sup>b</sup>		Probability of Latent Cancer Fatality		Collective Radiation Dose <sup>c</sup>		Probability of Latent Cancer Fatality	
	Annual (mrem/yr)	Total (mrem)			Annual (person-rem/yr)	Total (person-rem)		
			Annual	Total			Annual	Total
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	$1.1 \times 10^{-8}$	$1.1 \times 10^{-7}$	0.17	1.7	$8.5 \times 10^{-5}$	$8.5 \times 10^{-4}$
Percent of EPA standard (10 mrem per year)	<1	NA <sup>d</sup>	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	$2.1 \times 10^{-8}$	$2.1 \times 10^{-7}$	0.083	0.83	$4.2 \times 10^{-5}$	$4.2 \times 10^{-4}$
All pathways	0.062	0.62	$3.1 \times 10^{-8}$	$3.1 \times 10^{-7}$	0.25	2.5	$1.3 \times 10^{-4}$	$1.3 \times 10^{-3}$
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for Alternative A is 10 years.

b. Individual background radiation doses are about 300 mrem per year.

c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.

d. NA = not applicable.

**Annual Dose.** The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 ( $1.3 \times 10^{-4}$ ) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the*

*Environment*) and would result in less than 1 ( $3.1 \times 10^{-8}$ ) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

*Total Dose.* For the duration of the Alternative A (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 ( $1.3 \times 10^{-3}$ ) latent cancer fatality for the duration of the alternative.

#### **4.4.2 Impacts from Facility Accidents (Alternative A)**

DOE evaluated the potential impacts that could occur as result of accidents at the WVDP site during the implementation of Alternative A. Because all waste types (Class A, B, C, LLW, mixed LLW, RH-TRU, CH-TRU, and HLW) would be shipped under Alternative A, accidents involving the handling of all waste types were evaluated. As with the No Action Alternative, accidents involving the ongoing management of Tanks 8D-1 and 8D-2 were evaluated. Accidents involving ongoing or continuing activities at the WVDP site that were not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

One potential accident involved dropping two drums containing solidified Class C LLW from the Drum Cell. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of  $4.7 \times 10^{-5}$  rem. This accident could result in a radiation dose of  $1.6 \times 10^{-5}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.050 person-rem; this is equivalent to a probability of a latent cancer fatality of  $2.5 \times 10^{-5}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $4.0 \times 10^{-4}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A second potential accident involved the puncture of a drum containing Class C LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of  $1.2 \times 10^{-4}$  rem. This accident could result in a radiation dose of  $3.9 \times 10^{-5}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.12 person-rem; this is equivalent to a probability of a latent cancer fatality of  $6.0 \times 10^{-5}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $9.5 \times 10^{-4}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A third potential accident involved a drop of a pallet containing six Class C LLW drums, all of which were assumed to rupture. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of  $6.9 \times 10^{-4}$  rem. This accident could result in a radiation dose of  $2.4 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.74 person-rem; this is equivalent to a probability of a latent cancer

**Table 4-9. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Drum cell drop	0.1 – 0.01	$4.7 \times 10^{-5}$	$1.9 \times 10^{-8}$	$1.6 \times 10^{-5}$	$8.0 \times 10^{-9}$	0.050	$2.5 \times 10^{-5}$
Class C drum puncture <sup>b</sup>	0.1 – 0.01	$1.2 \times 10^{-4}$	$4.8 \times 10^{-8}$	$3.9 \times 10^{-5}$	$2.0 \times 10^{-8}$	0.12	$6.0 \times 10^{-5}$
Class C pallet drop <sup>b</sup>	0.1 – 0.01	$6.9 \times 10^{-4}$	$2.8 \times 10^{-7}$	$2.4 \times 10^{-4}$	$1.2 \times 10^{-7}$	0.74	$3.7 \times 10^{-4}$
Class C box puncture <sup>b</sup>	0.1 – 0.01	$1.2 \times 10^{-3}$	$4.8 \times 10^{-7}$	$3.9 \times 10^{-4}$	$2.0 \times 10^{-7}$	1.2	$6.0 \times 10^{-4}$
HIC <sup>c</sup> drop	0.1 – 0.01	$1.5 \times 10^{-3}$	$6.0 \times 10^{-7}$	$5.2 \times 10^{-4}$	$2.6 \times 10^{-7}$	1.6	$8.0 \times 10^{-4}$
CH-TRU drum puncture	0.1 – 0.01	0.038	$1.5 \times 10^{-5}$	0.013	$6.5 \times 10^{-6}$	41	0.021
RHWF <sup>d</sup> fire	$10^{-4} - 10^{-6}$	0.13	$5.2 \times 10^{-5}$	0.044	$2.2 \times 10^{-5}$	140	0.070
Collapse of Tank 8D-2 (wet) <sup>b</sup>	$10^{-4} - 10^{-6}$	$2.4 \times 10^{-3}$	$9.6 \times 10^{-7}$	$8.1 \times 10^{-4}$	$4.1 \times 10^{-7}$	2.5	$1.3 \times 10^{-3}$
Collapse of Tank 8D-2 (dry) <sup>b</sup>	$10^{-4} - 10^{-6}$	$2.8 \times 10^{-3}$	$1.1 \times 10^{-6}$	$9.5 \times 10^{-4}$	$4.8 \times 10^{-7}$	3.0	$1.5 \times 10^{-3}$

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

c. HIC= High integrity container.

d. RHWF= Remote-Handled Waste Facility.

**Table 4-10. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Drum cell drop	0.1 – 0.01	$4.7 \times 10^{-4}$	$1.9 \times 10^{-7}$	$1.8 \times 10^{-4}$	$9.0 \times 10^{-8}$	0.79	$4.0 \times 10^{-4}$
Class C drum puncture <sup>b</sup>	0.1 – 0.01	$1.2 \times 10^{-3}$	$4.8 \times 10^{-7}$	$4.3 \times 10^{-4}$	$2.2 \times 10^{-7}$	1.9	$9.5 \times 10^{-4}$
Class C pallet drop <sup>b</sup>	0.1 – 0.01	$6.8 \times 10^{-3}$	$2.7 \times 10^{-6}$	$2.6 \times 10^{-3}$	$1.3 \times 10^{-6}$	12	$6.0 \times 10^{-3}$
Class C box puncture <sup>b</sup>	0.1 – 0.01	0.012	$4.8 \times 10^{-6}$	$4.3 \times 10^{-3}$	$2.2 \times 10^{-6}$	19	$9.5 \times 10^{-3}$
HIC <sup>c</sup> drop	0.1 – 0.01	0.015	$6.0 \times 10^{-6}$	$5.6 \times 10^{-3}$	$2.8 \times 10^{-6}$	25	0.013
CH-TRU drum puncture	0.1 – 0.01	0.38	$1.5 \times 10^{-4}$	0.14	$7.0 \times 10^{-5}$	630	0.32
RHWF <sup>d</sup> fire	$10^{-4} - 10^{-6}$	1.3	$5.2 \times 10^{-4}$	0.47	$2.4 \times 10^{-4}$	2,100	1.1
Collapse of Tank 8D-2 (wet) <sup>b</sup>	$10^{-4} - 10^{-6}$	0.024	$9.6 \times 10^{-6}$	$8.9 \times 10^{-3}$	$4.5 \times 10^{-6}$	39	0.020
Collapse of Tank 8D-2 (dry) <sup>b</sup>	$10^{-4} - 10^{-6}$	0.028	$1.1 \times 10^{-5}$	0.010	$5.0 \times 10^{-6}$	46	0.023

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

c. HIC= High integrity container.

d. RHWF= Remote-Handled Waste Facility.

fatality of  $3.7 \times 10^{-4}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $6.0 \times 10^{-3}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A fourth potential accident involved the puncture of a box containing Class C LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of  $1.2 \times 10^{-3}$  rem. This accident could result in a radiation dose of  $3.9 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.2 person-rem; this is equivalent to a probability of a latent cancer fatality of  $6.0 \times 10^{-4}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of  $9.5 \times 10^{-3}$  for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A fifth potential accident involved dropping a high integrity container containing radioactive sludge and resin. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of  $1.5 \times 10^{-3}$  rem. This accident could result in a radiation dose of  $5.2 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.6 person-rem; this is equivalent to a probability of a latent cancer fatality of  $8.0 \times 10^{-4}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.013 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A sixth potential accident involved the puncture of a drum containing CH-TRU waste. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 0.038 rem. This accident could result in a radiation dose of 0.013 rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 41 person-rem; this is equivalent to a probability of a latent cancer fatality of 0.021. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.32 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A seventh potential accident involved a diesel fuel fire in the RHWF as a result of a leak in the fuel tank or fuel line of a truck. This fire would involve CH-TRU and RH-TRU waste. The frequency of this accident was estimated to be in the range of  $10^{-4}$  to  $10^{-6}$  per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 0.13 rem. This accident could result in a radiation dose of 0.044 rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 140 person-rem; this is equivalent to a probability of a latent cancer fatality of 0.070. Using 95-percent atmospheric conditions, this accident could result in about 1 latent cancer fatality for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

Although an accident involving dropping a HLW canister while loading a shipping cask could occur, the canisters are designed to resist breaching and tested to withstand a 7-meter (23-foot) drop onto an unyielding surface and it is unlikely that a canister would rupture if it were dropped during loading. Therefore, Tables 4-9 and 4-10 do not include analysis of this type of accident.

As in the No Action Alternative, DOE also analyzed accidents involving the ongoing management of Tanks 8D-1 and 8D-2, and determined that the consequences would be the same under both alternatives. These accidents assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. Two accidents were analyzed, one where the contents of the tank were kept wet, and another where the contents of the tank were allowed to dry. The frequencies of the accidents were estimated to be in the range of  $10^{-4}$  to  $10^{-6}$  per year.

The consequences of the accidents using 50-percent atmospheric conditions are presented in Table 4-9. If the contents of the tanks are kept wet, the accident could result in a radiation dose of  $2.4 \times 10^{-3}$  rem for the worker located at the site. This accident could result in a radiation dose of  $8.1 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 2.5 person-rem; this is equivalent to a probability of a latent cancer fatality of  $1.3 \times 10^{-3}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.020 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

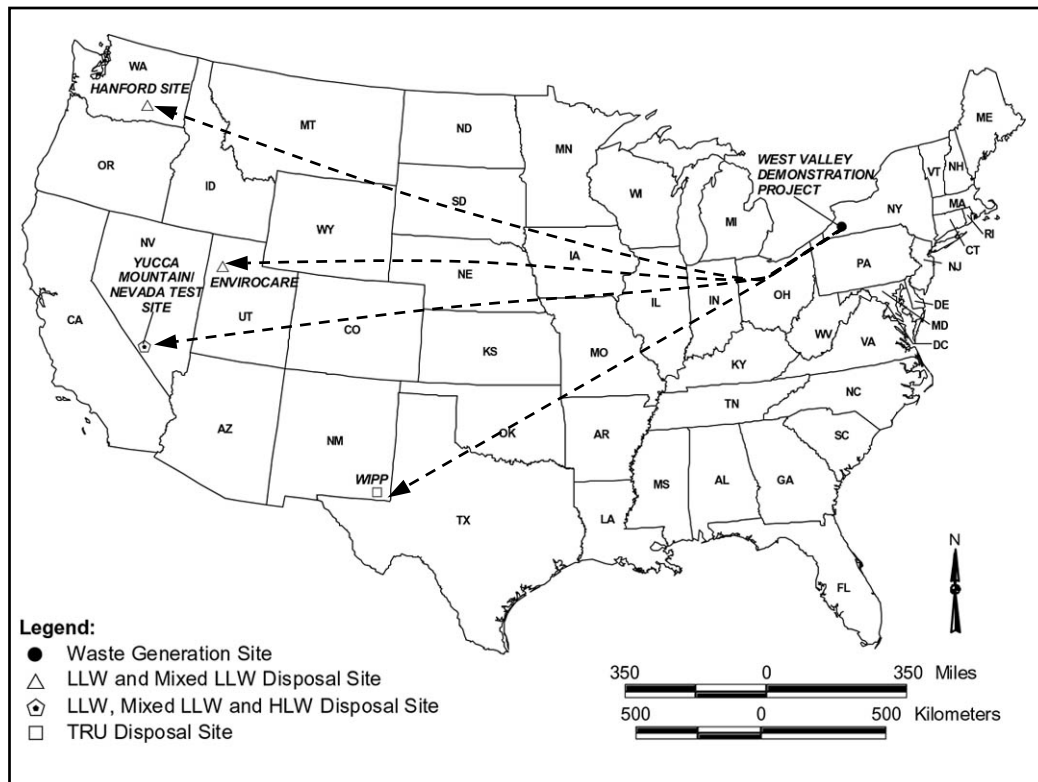
If the contents of the tanks are kept dry, this accident could result in a radiation dose of  $2.8 \times 10^{-3}$  rem for the worker located at the site (Table 4-9). This accident could result in a radiation dose of  $9.5 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 3.0 person-rem; this is equivalent to a probability of a latent cancer fatality of  $1.5 \times 10^{-3}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.023 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

The highest consequence accident in Table 4-9 was the fire at the RHWF. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases for this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### **4.4.3 Transportation (Alternative A)**

Under Alternative A, about 21,000 cubic meters (742,000 cubic feet) of radioactive waste would be shipped for disposal. These shipments would take place over 10 years. Although HLW would not be shipped to a geologic repository until sometime after 2025, HLW transportation impacts were included in Alternative A. Class A LLW would be shipped either to NTS, Hanford, or a commercial disposal site such as Envirocare. Class B and Class C LLW would be shipped either to the NTS or the Hanford Site. Mixed LLW, meeting disposal site waste acceptance criteria, would be shipped to Hanford, NTS, or a commercial disposal site such as Envirocare. TRU waste would be shipped to the WIPP site for disposal. HLW would be shipped to a geologic repository (assumed to be the proposed Yucca Mountain Repository for the purposes of evaluation in this EIS). The waste transportation destinations proposed under Alternative A are shown in Figure 4-2.

Transportation impacts were estimated assuming 100 percent of the waste would be shipped by truck and 100 percent of the waste would be shipped by rail. Table 4-11 lists the waste shipments associated with Alternative A. These shipments would take place over 10 years.



**Figure 4-2. Waste Destinations Under Alternative A**

#### 4.4.3.1 Total Impacts from Transportation Activities

The transportation impacts of shipping radioactive waste would be from two sources: incident-free transportation and transportation accidents. Both radiological impacts and nonradiological impacts are included in the analysis. The total impacts from transportation would be the sum of the impacts from incident-free transportation and transportation accidents. Additional details on these analyses are provided in Appendix D.

Table 4-12 lists the total transportation impacts by waste type and destination expected under Alternative A. If either trucks or trains were used to ship the radioactive waste, less than 1 fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States over the 10-year time period under Alternative A (U.S. Bureau of the Census 1997).

#### 4.4.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

**Worker Impacts.** If trucks were used to ship the waste, the maximally exposed worker would be the truck driver. This worker would receive a radiation dose of about 2,000 mrem per year based on driving the truck containing radioactive waste for 1,000 hours per year. This is equivalent to a probability of a latent cancer fatality of about  $8.0 \times 10^{-4}$ .

If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 190 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $7.6 \times 10^{-5}$ .

**Table 4-11. Waste Shipped Under Alternatives A or B**

Waste Type	Container Type	Waste Shipped (cubic feet) <sup>a</sup>	Number of Containers	Alternative A Shipments	Alternative B Shipments
Class A LLW	Boxes <sup>b</sup>	351,586	4,341	311 (truck) 156 (rail)	311 (truck) 156 (rail)
	Drums <sup>b</sup>	83,014	12,058	144 (truck) 72 (rail)	144 (truck) 72 (rail)
Class B LLW	HIC <sup>c</sup>	38,500	428	428 (truck) 107 (rail)	428 (truck) 107 (rail)
	Drums <sup>b</sup>	194	29	1 (truck) 1 (rail)	1 (truck) 1 (rail)
Class C LLW	HIC <sup>c</sup>	12,618	141	141 (truck) 36 (rail)	141 (truck) 36 (rail)
	55-gallon drums <sup>c</sup>	6,198	901	91 (truck) 23 (rail)	91 (truck) 23 (rail)
	71-gallon drums <sup>b</sup>	193,405	20,377	850 (truck) 213 (rail)	850 (truck) 213 (rail)
CH-TRU	Drums <sup>c</sup>	40,000	5,810	139 (truck) 139 (rail)	278 (truck) <sup>d</sup> 278 (rail) <sup>d</sup>
RH-TRU	Drums <sup>c</sup>	9,000	1,308	131 (truck) 33 (rail)	262 (truck) <sup>e</sup> 66 (rail) <sup>f</sup>
MLLW	Drums <sup>b</sup>	7,889	1,146	14 (truck) 7 (rail)	14 (truck) 7 (rail)
HLW	Canisters <sup>c</sup>		300 <sup>g</sup>	300 (truck) 60 (rail)	600 (truck) <sup>h</sup> 120 (rail) <sup>i</sup>
Total		742,404	46,839	2,550 (truck) 847 (rail)	3,120 (truck) <sup>j</sup> 1,079 (rail) <sup>k</sup>

Acronyms: LLW = low-level radioactive waste; HIC = high-integrity container; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste

a. To convert cubic feet to cubic meters, multiply by 0.028.

b. Shipped in Type A shipping container.

c. Shipped in Type B shipping container.

d. 139 CH-TRU shipments from WVDP to interim storage, 139 CH-TRU shipments from interim storage to disposal.

e. 131 RH-TRU shipments from WVDP to interim storage, 131 RH-TRU shipments from interim storage to disposal.

f. 33 RH-TRU shipments from WVDP to interim storage, 33 RH-TRU shipments from interim storage to disposal.

g. Assumed to be 300 for purposes of analysis; actual number of canisters is 275.

h. 300 HLW shipments from WVDP to interim storage, 300 HLW shipments from interim storage to disposal.

i. 60 HLW shipments from WVDP to interim storage, 60 HLW shipments from interim storage to disposal.

j. Includes 270 TRU waste, and 300 HLW, truck shipments from interim storage to disposal. Alternative B would load the same number of truck shipments (2,550) at WVDP for shipment offsite as Alternative A.

k. Includes 172 TRU waste, and 60 HLW, rail shipments from interim storage to disposal. Alternative B would load the same number of rail shipments (847) at WVDP for shipment offsite as Alternative A.

**Public Impacts.** If trucks were used to ship the waste, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 19 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $9.5 \times 10^{-6}$ .

If trains were used to ship the waste, the maximally exposed member of the public would be a railyard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $1.8 \times 10^{-5}$ .

**Table 4-12. Transportation Impacts Under Alternative A**

Waste Type	Destination	Incident-Free		Radiological Accident Risk (LCFs)	Pollution Health Effects (Fatalities)	Traffic Fatalities	Total Fatalities
		Public	Worker				
		(LCFs)					
Truck							
Class A LLW	Envirocare	0.021	0.025	$1.1 \times 10^{-4}$	$5.7 \times 10^{-3}$	0.030	0.081
	Hanford Site	0.025	0.029	$1.2 \times 10^{-4}$	$6.3 \times 10^{-3}$	0.038	0.098
	NTS	0.026	0.029	$1.4 \times 10^{-4}$	$7.6 \times 10^{-3}$	0.036	0.098
Class B LLW	Hanford Site	0.024	0.052	$6.9 \times 10^{-7}$	$5.9 \times 10^{-3}$	0.035	0.12
	NTS	0.024	0.050	$7.9 \times 10^{-7}$	$7.1 \times 10^{-3}$	0.034	0.11
Class C LLW	Hanford Site	0.072	0.16	$4.6 \times 10^{-7}$	0.018	0.11	0.36
	NTS	0.074	0.15	$5.4 \times 10^{-7}$	0.022	0.10	0.35
CH-TRU	WIPP	$6.9 \times 10^{-3}$	$8.0 \times 10^{-3}$	$6.2 \times 10^{-4}$	$2.3 \times 10^{-3}$	0.012	0.030
RH-TRU	WIPP	$5.4 \times 10^{-3}$	0.011	$6.2 \times 10^{-9}$	$2.2 \times 10^{-3}$	0.011	0.030
MLLW	Envirocare	$6.4 \times 10^{-4}$	$7.6 \times 10^{-4}$	$8.7 \times 10^{-6}$	$1.8 \times 10^{-4}$	$9.2 \times 10^{-4}$	$2.5 \times 10^{-3}$
	Hanford Site	$7.7 \times 10^{-4}$	$9.1 \times 10^{-4}$	$9.4 \times 10^{-6}$	$1.9 \times 10^{-4}$	$1.2 \times 10^{-3}$	$3.0 \times 10^{-3}$
	NTS	$7.9 \times 10^{-4}$	$8.8 \times 10^{-4}$	$1.1 \times 10^{-5}$	$2.3 \times 10^{-4}$	$1.1 \times 10^{-3}$	$3.0 \times 10^{-3}$
HLW	Repository	0.017	0.035	$8.1 \times 10^{-7}$	$5.8 \times 10^{-3}$	0.024	0.082
Total Truck Fatalities: 0.69 – 0.72							
Rail							
Class A LLW	Envirocare	0.037	0.026	$4.4 \times 10^{-4}$	$8.0 \times 10^{-3}$	0.026	0.097
	Hanford Site	0.037	0.028	$4.8 \times 10^{-4}$	$8.2 \times 10^{-3}$	0.034	0.11
	NTS	0.038	0.035	$4.4 \times 10^{-4}$	$8.1 \times 10^{-3}$	0.033	0.11
Class B LLW	Hanford Site	0.035	0.026	$2.8 \times 10^{-6}$	$3.9 \times 10^{-3}$	0.016	0.081
	NTS	0.036	0.036	$2.5 \times 10^{-6}$	$3.8 \times 10^{-3}$	0.017	0.093
Class C LLW	Hanford Site	0.11	0.081	$1.0 \times 10^{-6}$	0.012	0.049	0.25
	NTS	0.11	0.11	$9.1 \times 10^{-7}$	0.012	0.053	0.29
CH-TRU	WIPP	$6.9 \times 10^{-3}$	$6.5 \times 10^{-3}$	$1.6 \times 10^{-4}$	$3.4 \times 10^{-3}$	0.018	0.035
RH-TRU	WIPP	$5.5 \times 10^{-3}$	$5.1 \times 10^{-3}$	$2.0 \times 10^{-8}$	$8.0 \times 10^{-4}$	$4.2 \times 10^{-3}$	0.016
MLLW	Envirocare	$1.1 \times 10^{-3}$	$8.0 \times 10^{-4}$	$3.4 \times 10^{-5}$	$2.4 \times 10^{-4}$	$8.1 \times 10^{-4}$	$3.0 \times 10^{-3}$
	Hanford Site	$1.1 \times 10^{-3}$	$8.6 \times 10^{-4}$	$3.8 \times 10^{-5}$	$2.5 \times 10^{-4}$	$1.0 \times 10^{-3}$	$3.3 \times 10^{-3}$
	NTS	$1.2 \times 10^{-3}$	$1.1 \times 10^{-3}$	$3.4 \times 10^{-5}$	$2.5 \times 10^{-4}$	$1.0 \times 10^{-3}$	$3.5 \times 10^{-3}$
HLW	Repository	$6.3 \times 10^{-3}$	0.011	$2.5 \times 10^{-7}$	$4.2 \times 10^{-3}$	0.019	0.041
Total Rail Fatalities: 0.52 – 0.59							

Acronyms: LCFs = latent cancer fatalities; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste; NTS = Nevada Test Site; WIPP = Waste Isolation Pilot Plant. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

#### 4.4.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents

For waste shipped under Alternative A, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Since one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident are the same. The probabilities of the truck and rail accidents are slightly different. The probability of the truck accident was  $6 \times 10^{-7}$  per year. For rail, the probability of the accident was  $1 \times 10^{-7}$  per year. The maximally exposed individual would receive a radiation dose of about 25 rem from this accident, which is equivalent to a latent cancer fatality risk of 0.012. The population would receive a collective radiation dose of approximately 6,600 person-rem from this accident. This could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota



concentration guides for the CH-TRU accident was less than 1. Therefore, the radioactive releases from the CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### **4.4.4 Offsite Impacts (Alternative A)**

Under Alternative A, 19,200 cubic meters (685,515 cubic feet) of LLW and 221 cubic meters (7,889 cubic feet) of mixed LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP LLW and mixed LLW inventory were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from  $3.2 \times 10^{-2}$  to  $3.6 \times 10^{-2}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between  $5.1 \times 10^{-5}$  and  $2.1 \times 10^{-15}$ .

In addition, approximately 1,372 cubic meters (49,000 cubic feet) of TRU waste would be disposed of at WIPP. Disposal of this waste volume at WIPP would result in a probability that a worker would incur a latent cancer fatality of  $1.0 \times 10^{-2}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of  $3.0 \times 10^{-9}$ . The population within 80 kilometers (50 miles) of the site would have a probability of incurring a latent cancer fatality of  $3.0 \times 10^{-6}$ .

Disposal of 300 canisters of WVDP HLW<sup>1</sup> at a geologic repository at Yucca Mountain would result in a probability that a worker would incur a latent cancer fatality of  $6.8 \times 10^{-2}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of  $3.1 \times 10^{-7}$ . The population within 80 kilometers (50 miles) of the site would have a probability of incurring a latent cancer fatality of  $2.0 \times 10^{-2}$ .

Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C-10, explains how these impacts were derived.

#### **4.5 IMPACTS OF ALTERNATIVE B – OFFSITE SHIPMENT OF LLW AND MIXED LLW TO DISPOSAL, SHIPMENT OF HLW AND TRU WASTE TO INTERIM STORAGE, AND INTERIM STABILIZATION OF THE WASTE STORAGE TANKS**

Under **Alternative B**, LLW and mixed LLW would be shipped offsite for disposal at the same locations as Alternative A. TRU wastes would be shipped for interim storage at one of five DOE sites: Hanford Site; INEEL; ORNL; SRS; or WIPP. TRU wastes would subsequently be shipped to WIPP (or would remain at WIPP) for disposal. HLW would be shipped to SRS or Hanford for interim storage, with subsequent shipment to Yucca Mountain for disposal.

It is assumed that the shipment of LLW and mixed LLW to disposal would occur within the next 10 years, and that TRU waste and HLW would be shipped to interim storage during that same 10 years. Ultimate disposal of TRU wastes and HLW wastes would be subject to the same constraints described under Alternative A; however, the impacts of transporting these wastes to their ultimate disposal sites have been included in the impact analyses for this alternative. The waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization.

---

<sup>1</sup> For purposes of analysis, DOE assumed that vitrification of HLW at WVDP would result in the production of 300 canisters. Vitrification is now complete and has resulted in the production of 275 canisters. Therefore, the impacts associated with the 275 canisters actually produced would be lower than the impacts analyzed.

### 4.5.1 Human Health Impacts (Alternative B)

This section characterizes the radiological impacts from Alternative B activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material from controlled releases to the environment. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services.

**Worker Impacts.** Under Alternative B, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, and offsite interim storage of RH-TRU, CH-TRU, and HLW prior to disposal. In addition, the waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization of the tanks. Table 4-13 presents the radiological impacts to involved and noninvolved workers for Alternative B. During the 10-year time period, the collective radiation dose to involved workers was estimated to be about 63 person-rem or about 6.3 person-rem per year from activities under Alternative B. Over this same time period, the individual radiation dose to the average involved worker would be about 260 mrem per year. This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 ( $1.0 \times 10^{-4}$ ) latent cancer fatality or a chance of about 1 in 10,000 per year. These radiation doses include the radiation doses from interim stabilization of the waste storage tanks.

**Table 4-13. Radiation Doses for Involved and Noninvolved Workers Under Alternative B**

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers <sup>a</sup>	Alternative B activities	10	6.3	63	$2.5 \times 10^{-3}$	0.025
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	15	150	$6.0 \times 10^{-3}$	0.060
All workers	Total	10	21	210	$8.5 \times 10^{-3}$	0.085
Worker Population	Activity	Time Period (years)	Individual Dose		Latent Cancer Fatalities	
			Annual (mrem/yr)	Total (mrem)	Annual	Total
Involved workers <sup>a</sup>	Alternative B activities	10	260	2,600	$1.0 \times 10^{-4}$	$1.0 \times 10^{-3}$
Noninvolved workers <sup>b</sup>	Ongoing operations of WVDP <sup>b</sup>	10	59	590	$2.4 \times 10^{-5}$	$2.4 \times 10^{-4}$

a. Involved workers would be those individuals that actively participate in Alternative B.

b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in Alternative B.

In addition to radiation doses from Alternative B activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both Alternative B activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 210 person-rem over the duration of Alternative B or about 21 person-rem per year (Table 4-13). This dose is equivalent to less than 1 (0.085) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under Alternative B, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

**Public Impacts.** Under Alternative B, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. In addition, the waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization of the tanks. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP and thus would be the same as under the No Action Alternative and Alternative A. Annual and total radiation doses to the public (maximally exposed individual and collective population) are listed in Table 4-14.

**Table 4-14. Radiation Doses to the Public Under Alternative B<sup>a</sup>**

Activity	Maximally Exposed Individual				Population Around WVDP Site			
	Individual Radiation Dose <sup>b</sup>		Probability of Latent Cancer Fatality		Collective Radiation Dose <sup>c</sup>		Probability of Latent Cancer Fatality	
					Annual (person-rem/yr)	Total (person-rem)		
	Annual (mrem/yr)	Total (mrem)					Annual	Total
Interim Stabilization of Waste Storage Tanks								
Airborne releases <sup>d</sup>	$4.6 \times 10^{-7}$	$4.6 \times 10^{-7}$	$2.3 \times 10^{-13}$	$2.3 \times 10^{-13}$	$1.2 \times 10^{-5}$	$1.2 \times 10^{-5}$	$6.0 \times 10^{-9}$	$6.0 \times 10^{-9}$
Percent of EPA standard (10 mrem per year)	<1	NA <sup>e</sup>	NA	NA	NA	NA	NA	NA
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	$1.1 \times 10^{-8}$	$1.1 \times 10^{-7}$	0.17	1.7	$8.5 \times 10^{-5}$	$8.5 \times 10^{-4}$
Percent of EPA standard (10 mrem per year)	<1	NA <sup>e</sup>	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	$2.1 \times 10^{-8}$	$2.1 \times 10^{-7}$	0.083	0.83	$4.2 \times 10^{-5}$	$4.2 \times 10^{-4}$
All pathways	0.062	0.62	$3.1 \times 10^{-8}$	$3.1 \times 10^{-7}$	0.25	2.5	$1.3 \times 10^{-4}$	$1.3 \times 10^{-3}$
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for Alternative B is 10 years.

b. Individual background radiation doses are about 300 mrem per year.

c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.

d. Interim stabilization was assumed to take place in less than 1 year.

e. NA = not applicable.

**Annual Dose.** The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 ( $1.3 \times 10^{-4}$ ) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*) and would result in less than 1 ( $3.1 \times 10^{-8}$ ) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

The radiation doses from atmospheric releases during interim stabilization of the waste storage tanks were  $4.6 \times 10^{-7}$  mrem for the maximally exposed individual and  $1.2 \times 10^{-5}$  person-rem for the population around the WVDP site. This is equivalent to less than 1 ( $6.0 \times 10^{-9}$ ) latent cancer fatality during interim stabilization.

*Total Dose.* For the duration of the No Action Alternative (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 ( $1.3 \times 10^{-3}$ ) latent cancer fatality over the duration of Alternative B.

Interim stabilization of the waste storage tanks was assumed to take place in less than 1 year. Therefore, the total radiation doses from interim stabilization are the same as the annual radiation doses in Table 4-14.

#### **4.5.2 Impacts from Facility Accidents (Alternative B)**

With the exception of interim stabilization of Tanks 8D-1 and 8D-2, the onsite activities proposed under Alternative B would be the same as those proposed under Alternative A. The facility accidents characterized previously in Section 4.4.2 would be representative of Alternative B and would have the same consequences. Therefore, the potential facility accidents characterized in Section 4.4.2 and their consequences will not be repeated here. As with the No Action Alternative and Alternative A, accidents involving ongoing or continuing activities at the WVDP site that were not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

As described in Chapter 2, under Alternative B interim stabilization, Tanks 8D-1 and 8D-2 would be filled with approximately 102 centimeters (40 inches) of grout. An accident involving a containment system failure during interim stabilization would have a frequency in the range of  $10^{-6}$  to  $10^{-8}$  per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-15. For an onsite worker, this accident could result in a radiation dose of 0.015 rem. This accident could result in a radiation dose of  $4.9 \times 10^{-3}$  to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the WVDP site, this accident could result in a collective radiation dose of 15 person-rem; this is equivalent to a probability of a latent cancer fatality of  $7.5 \times 10^{-3}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.12 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-16). After the completion of interim stabilization, the risk from this accident would be eliminated.

DOE also analyzed the impacts of an accident involving Tanks 8D-1 and 8D-2 after they had been stabilized. This accident assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. The frequency of this accident was estimated to be in the range of  $10^{-4}$  to  $10^{-6}$  per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-15.

**Table 4-15. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Containment system failure during interim stabilization of Tank 8D-2 <sup>b</sup>	$10^{-6} - 10^{-8}$	0.015	$6.0 \times 10^{-6}$	$4.9 \times 10^{-3}$	$2.5 \times 10^{-6}$	15	$7.5 \times 10^{-3}$
Collapse of Tank 8D-2 (grouted) <sup>b</sup>	$10^{-4} - 10^{-6}$	$1.3 \times 10^{-3}$	$5.2 \times 10^{-7}$	$4.5 \times 10^{-4}$	$2.3 \times 10^{-7}$	1.4	$7.0 \times 10^{-4}$

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

**Table 4-16. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions**

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population <sup>a</sup>	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Containment system failure during interim stabilization of Tank 8D-2 <sup>b</sup>	$10^{-6} - 10^{-8}$	0.14	$5.6 \times 10^{-5}$	0.054	$2.7 \times 10^{-5}$	240	0.12
Collapse of Tank 8D-2 (grouted) <sup>b</sup>	$10^{-4} - 10^{-6}$	0.013	$5.2 \times 10^{-6}$	$4.9 \times 10^{-3}$	$2.5 \times 10^{-6}$	22	0.011

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.

b. Ground-level release.

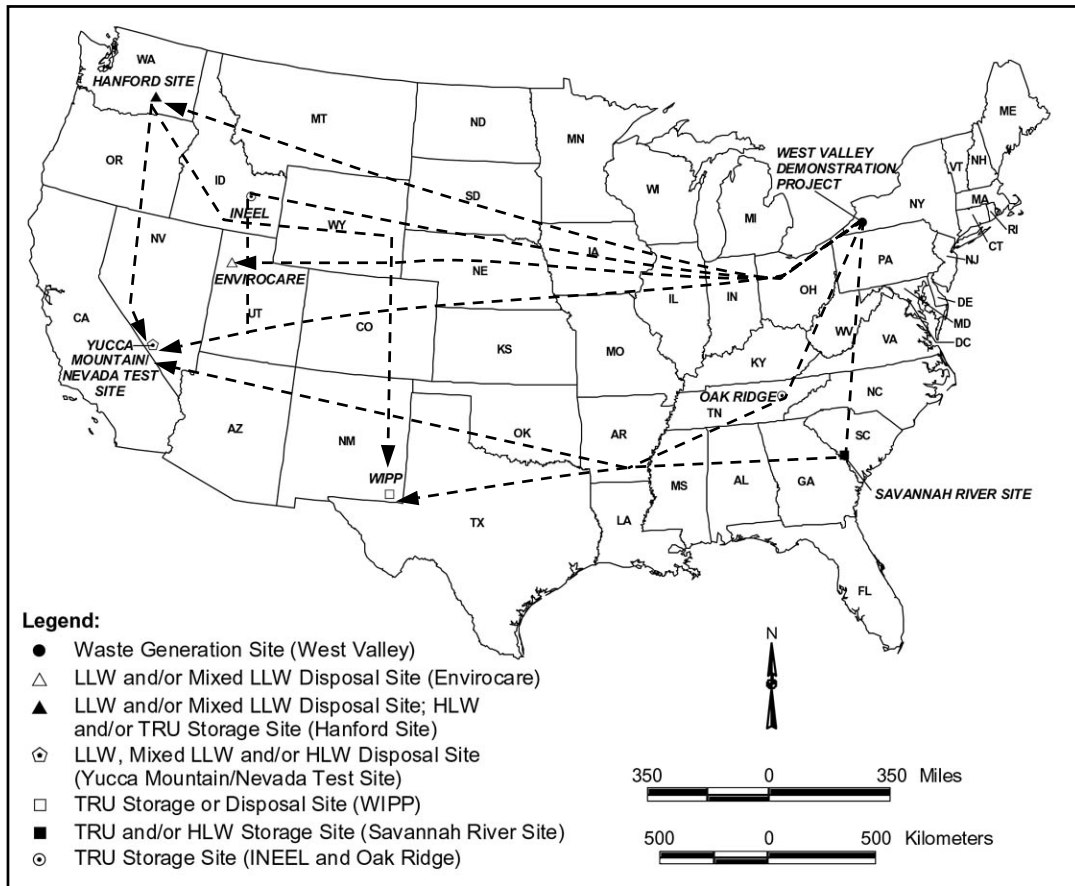
For a worker located at the site, this accident could result in a radiation dose of  $1.3 \times 10^{-3}$  rem. This accident could result in a radiation dose of  $4.5 \times 10^{-4}$  rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.4 person-rem; this is equivalent to a probability of a latent cancer fatality of  $7.0 \times 10^{-4}$ . Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.011 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-16).

The highest consequence accident in Table 4-15 was the accident involving a containment system failure during interim stabilization. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases from this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

### 4.5.3 Transportation (Alternative B)

Under Alternative B, about 21,000 cubic meters (742,000 cubic feet) of radioactive waste would be shipped for disposal. These are the same volumes that would be shipped under Alternative A. These shipments would take place over 10 years. Although HLW would not be shipped to a geologic repository until sometime after 2025, HLW transportation impacts were included in Alternative B. As was the case

for Alternative A, under Alternative B Class A LLW would be shipped either to NTS, Hanford, or a commercial disposal site such as Envirocare; Class B and Class C LLW would be shipped either to the NTS or the Hanford Site; and mixed LLW would be shipped to Hanford, NTS, or a commercial disposal site such as Envirocare. In contrast to Alternative A, TRU waste would be shipped first to Hanford, INEEL, ORNL or SRS for storage, then to WIPP for disposal. TRU waste could also be shipped to WIPP for interim storage prior to disposal there. HLW would be shipped first to the SRS or Hanford for storage, then to a geologic repository for disposal (again, assumed to be the proposed Yucca Mountain Repository for the purposes of evaluation in this EIS). The waste transportation destinations proposed under Alternative B are shown in Figure 4-3.



**Figure 4-3. Waste Destinations Under Alternative B**

Transportation impacts were estimated assuming that 100 percent of the waste would be shipped by truck and that 100 percent of the waste would be shipped by rail. Table 4-11 lists the waste shipments associated with Alternative B. Because only the destinations for TRU waste and HLW vary between Alternatives A and B, the reader will see very little difference among the impacts to workers or the public for these alternatives.

#### 4.5.3.1 Total Impacts from Transportation Activities

Table 4-17 lists the total transportation impacts by waste type and destination expected under Alternative B. If either trucks or trains were used to ship the radioactive waste, less than one fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States during the 10-year time period under Alternative B (U.S. Bureau of the Census 1997).

**Table 4-17. Transportation Impacts Under Alternative B**

Waste Type	Destination	Incident-Free		Radiological Accident Risk (LCFs)	Pollution Health Effects	Traffic Fatalities	Total Fatalities
		Public	Worker				
		(LCFs)					
Truck							
Class A LLW	Envirocare	0.021	0.025	$1.1 \times 10^{-4}$	$5.7 \times 10^{-3}$	0.030	0.081
	Hanford Site	0.025	0.029	$1.2 \times 10^{-4}$	$6.3 \times 10^{-3}$	0.038	0.098
	NTS	0.026	0.029	$1.4 \times 10^{-4}$	$7.6 \times 10^{-3}$	0.036	0.098
Class B LLW	Hanford Site	0.024	0.052	$6.9 \times 10^{-7}$	$5.9 \times 10^{-3}$	0.035	0.12
	NTS	0.024	0.050	$7.9 \times 10^{-7}$	$7.1 \times 10^{-3}$	0.034	0.11
Class C LLW	Hanford Site	0.072	0.16	$4.6 \times 10^{-7}$	0.018	0.11	0.36
	NTS	0.074	0.15	$5.4 \times 10^{-7}$	0.022	0.10	0.35
CH-TRU	SRS → WIPP	0.010	0.014	$1.8 \times 10^{-3}$	$3.8 \times 10^{-3}$	0.022	0.052
	INEEL → WIPP	0.014	0.020	$1.5 \times 10^{-3}$	$4.2 \times 10^{-3}$	0.025	0.065
	ORNL → WIPP	$8.9 \times 10^{-3}$	0.013	$1.1 \times 10^{-3}$	$3.1 \times 10^{-3}$	0.017	0.043
	Hanford → WIPP	0.017	0.023	$1.7 \times 10^{-3}$	$4.9 \times 10^{-3}$	0.032	0.079
RH-TRU	SRS → WIPP	$8.1 \times 10^{-3}$	0.017	$1.8 \times 10^{-8}$	$3.6 \times 10^{-3}$	0.021	0.050
	INEEL → WIPP	0.011	0.026	$1.7 \times 10^{-8}$	$4.0 \times 10^{-3}$	0.024	0.065
	ORNL → WIPP	$7.0 \times 10^{-3}$	0.016	$1.1 \times 10^{-8}$	$2.9 \times 10^{-3}$	0.016	0.042
	Hanford → WIPP	0.014	0.031	$1.9 \times 10^{-8}$	$4.6 \times 10^{-3}$	0.030	0.080
MLLW	Envirocare	$6.4 \times 10^{-4}$	$7.6 \times 10^{-4}$	$8.7 \times 10^{-6}$	$1.8 \times 10^{-4}$	$9.2 \times 10^{-4}$	$2.5 \times 10^{-3}$
	Hanford Site	$7.7 \times 10^{-4}$	$9.1 \times 10^{-4}$	$9.4 \times 10^{-6}$	$1.9 \times 10^{-4}$	$1.2 \times 10^{-3}$	$3.0 \times 10^{-3}$
	NTS	$7.9 \times 10^{-4}$	$8.8 \times 10^{-4}$	$1.1 \times 10^{-5}$	$2.3 \times 10^{-4}$	$1.1 \times 10^{-3}$	$3.0 \times 10^{-3}$
HLW	SRS → Repository	0.027	0.054	$2.2 \times 10^{-6}$	$9.6 \times 10^{-3}$	0.047	0.14
	Hanford Site → Repository	0.025	0.055	$1.2 \times 10^{-6}$	$8.0 \times 10^{-3}$	0.037	0.12
Total Truck Fatalities: 0.76 – 0.87							

**Table 4-17. Transportation Impacts Under Alternative B (cont)**

Waste Type	Destination	Incident-Free		Radiological Accident Risk (LCFs)	Pollution Health Effects	Traffic Fatalities	Total Fatalities
		Public	Worker				
		(LCFs)					
Rail							
Class A LLW	Envirocare	0.037	0.026	$4.4 \times 10^{-4}$	$8.0 \times 10^{-3}$	0.026	0.097
	Hanford Site	0.037	0.028	$4.8 \times 10^{-4}$	$8.2 \times 10^{-3}$	0.034	0.11
	NTS	0.038	0.035	$4.4 \times 10^{-4}$	$8.1 \times 10^{-3}$	0.033	0.11
Class B LLW	Hanford Site	0.035	0.026	$2.8 \times 10^{-6}$	$3.9 \times 10^{-3}$	0.016	0.081
	NTS	0.036	0.036	$2.5 \times 10^{-6}$	$3.8 \times 10^{-3}$	0.017	0.093
Class C LLW	Hanford Site	0.11	0.081	$1.0 \times 10^{-6}$	0.012	0.049	0.25
	NTS	0.11	0.11	$9.1 \times 10^{-7}$	0.012	0.053	0.29
CH-TRU	SRS → WIPP	0.018	0.018	$6.9 \times 10^{-4}$	$8.9 \times 10^{-3}$	0.057	0.10
	INEEL → WIPP	0.020	0.020	$1.0 \times 10^{-3}$	0.010	0.038	0.089
	ORNL → WIPP	0.016	0.017	$6.2 \times 10^{-4}$	$8.0 \times 10^{-3}$	0.031	0.073
	Hanford → WIPP	0.023	0.021	$1.3 \times 10^{-3}$	0.012	0.053	0.11
RH-TRU	SRS → WIPP	0.014	0.014	$7.3 \times 10^{-8}$	$2.1 \times 10^{-3}$	0.013	0.044
	INEEL → WIPP	0.016	0.015	$1.2 \times 10^{-7}$	$9.7 \times 10^{-3}$	0.036	0.077
	ORNL → WIPP	0.013	0.013	$6.8 \times 10^{-8}$	$7.5 \times 10^{-3}$	0.030	0.063
	Hanford → WIPP	0.018	0.017	$1.5 \times 10^{-7}$	0.011	0.050	0.096
MLLW	Envirocare	$1.1 \times 10^{-3}$	$8.0 \times 10^{-4}$	$3.4 \times 10^{-5}$	$2.4 \times 10^{-4}$	$8.1 \times 10^{-4}$	$3.0 \times 10^{-3}$
	Hanford Site	$1.1 \times 10^{-3}$	$8.6 \times 10^{-4}$	$3.8 \times 10^{-5}$	$2.5 \times 10^{-4}$	$1.0 \times 10^{-3}$	$3.3 \times 10^{-3}$
	NTS	$1.2 \times 10^{-3}$	$1.1 \times 10^{-3}$	$3.4 \times 10^{-5}$	$2.5 \times 10^{-4}$	$1.0 \times 10^{-3}$	$3.5 \times 10^{-3}$
HLW	SRS → Repository	$9.9 \times 10^{-3}$	0.019	$2.5 \times 10^{-7}$	$6.1 \times 10^{-3}$	0.038	0.074
	Hanford Site → Repository	$9.4 \times 10^{-3}$	0.019	$3.3 \times 10^{-7}$	$5.3 \times 10^{-3}$	0.034	0.067
Total Rail Fatalities: 0.62 – 0.78							

Acronyms: LCFs = latent cancer fatalities; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste; SRS = Savannah River Site; NTS = Nevada Test Site; WIPP = Waste Isolation Pilot Plant; INEEL = Idaho National Engineering and Environmental Laboratory; ORNL = Oak Ridge National Laboratory. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

#### 4.5.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

**Worker Impacts.** If trucks were used to ship the waste, the maximally exposed worker would be the truck driver. This worker would receive a radiation dose of about 2,000 mrem per year based on driving the truck containing radioactive waste for 1,000 hours per year. This is equivalent to a probability of a latent cancer fatality of about  $8.0 \times 10^{-4}$ .

If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 190 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $7.6 \times 10^{-5}$ .

**Public Impacts.** If trucks were used to ship the waste, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 19 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $9.5 \times 10^{-6}$ .

If trains were used to ship the waste, the maximally exposed member of the public would be a rail yard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about  $1.8 \times 10^{-5}$ .



#### 4.5.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents

As is the case for Alternative A, for waste shipped under Alternative B, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Because one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident are the same. However, the probability of the truck and rail accidents are slightly different. The probability of the truck accident was  $1 \times 10^{-6}$  per year. For rail, the probability of the accident was  $5 \times 10^{-7}$  per year. The maximally exposed individual would receive a radiation dose of about 25 rem from this accident, which is equivalent to a latent cancer fatality risk of 0.012. The population would receive a collective radiation dose of approximately 6,600 person-rem from this accident. This could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for the CH-TRU accident was less than 1. Therefore, the radioactive releases from the CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

#### 4.5.4 Offsite Impacts (Alternative B)

Under Alternative B, LLW and mixed LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP LLW and mixed LLW inventory were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from  $3.2 \times 10^{-2}$  to  $3.6 \times 10^{-2}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between  $5.1 \times 10^{-5}$  and  $2.1 \times 10^{-15}$ .

In addition, approximately 1,372 cubic meters (49,000 cubic feet) of TRU waste would be stored at Hanford, INEEL, ORNL, SRS, or WIPP. Interim storage of this waste volume would result in a probability that a worker would incur a latent cancer fatality of between  $2.5 \times 10^{-3}$  and  $1.6 \times 10^{-4}$ . The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between  $6.9 \times 10^{-7}$  and  $2.1 \times 10^{-10}$ . The populations within 80 kilometers (50 miles) of the sites would have a probability of incurring a latent cancer fatality of between  $2.6 \times 10^{-3}$  and  $2.3 \times 10^{-5}$ .

HLW currently stored at WVDP would be stored at Hanford or SRS. Interim storage of 300 canisters of WVDP HLW at these sites would result in a probability that a worker would incur a latent cancer fatality of between  $2.0 \times 10^{-2}$  and  $3.6 \times 10^{-2}$ .

Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C-10, explains how these impacts were derived.

### 4.6 ENVIRONMENTAL JUSTICE IMPACTS

In February 1994, the President issued Executive Order 12898, titled *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* [59 Fed. Reg. 7629-7633 (1994)]. This Order directs federal agencies to incorporate environmental justice as part of their missions. As such, federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Council on Environmental Quality has issued guidance (CEQ 1997) to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed. In this guidance, the Council encouraged federal agencies to supplement the guidance with

their own specific procedures tailored to particular programs or activities of an agency. DOE has prepared the *Draft Guidance on Incorporating Environmental Justice Considerations into the Department of Energy's National Environmental Policy Act Process* (DOE 2000b) based on Executive Order 12898 and the Council on Environmental Quality environmental justice guidance.

Among other things, the DOE draft guidance states that even for actions that are at the low end of the sliding scale with respect to the significance of environmental impacts, some consideration (which could be qualitative) is needed to show that DOE considered environmental justice concerns. DOE needs to demonstrate that it considered apparent pathways or uses of resources that are unique to a minority or low-income community before determining whether, even in light of these special pathways or practices, there are disproportionately high and adverse impacts on the minority or low-income population. The DOE draft guidance also defines "minority population" as a populace where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

For this Waste Management EIS, DOE applied the environmental justice guidance to determine whether there could be any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the WVDP site as a result of the implementation of any of the alternatives analyzed. Analysis of environmental justice concerns was based on an assessment of the impacts reported in Sections 4.3 through 4.5. Although no high and adverse impacts were identified to any receptor from either the proposed onsite waste management actions or the offsite shipments of wastes, DOE considered whether minority or low-income populations would be disproportionately affected by the ongoing management of the WVDP site, particularly taking into account subsistence fishing on the part of some residents of the Cattaraugus Reservation of the Seneca Nation of Indians.

***Subsistence Consumption of Fish.*** Consumption of food and water is a major source of exposure to potentially hazardous substances for U.S. residents. These pathways are also expected to be the primary routes through which a resident of the Cattaraugus Reservation of the Seneca Nation could be exposed to releases from the WVDP site. Because a member of the Seneca Nation may consume more fish from local waters than other members of the population around the WVDP site, DOE performed an additional dose assessment for increased fish consumption.

Specifically, DOE evaluated the potential human health impacts that could occur from the consumption by one individual of up to 62 kilograms (137 pounds) of game fish per year, compared to 21 kilograms (46 pounds) of game fish assumed for the maximally exposed individual in the WVDP Annual Site Environmental Reports. The 62-kilogram consumption rate represents the 95th percentile fish consumption rate for Native Americans from the *Exposure Factors Handbook* (EPA 1997).

Over the period 1995 through 1999, the average radiation dose from fish consumption reported in the WVDP Annual Site Environmental Reports (WVNS 1996, 1997, 1998, 1999, 2000c) was 0.016 mrem per year, based on eating 21 kilograms (46 pounds) of fish per year. The radiation dose from eating 62 kilograms (137 pounds) of fish per year was 0.05 mrem per year. These radiation doses are less than 0.1 percent of the DOE standard of 100 mrem per year from DOE Order 5400.5 and would result in less than 1 ( $2.5 \times 10^{-8}$ ) latent cancer fatality. Based on this analysis, DOE concludes that implementation of any of the alternatives would not result in disproportionately high and adverse impacts on the minority or low-income population in the region, even in light of possible increased exposure through subsistence fishing. Additional information concerning the assessment of human health impacts is provided in Appendix C.

***Transportation.*** The transportation of radioactive waste would use the nation's existing highways and railroads. As described in previous sections, the total impacts from transportation would be very low

(less than 1 fatality over 10 years) and therefore would not present a large health or safety risk to the population as a whole, or to workers or individuals along transportation routes. Based on this analysis, DOE concludes that implementation of any of the alternatives would not result in disproportionately high and adverse impacts on the minority or low-income populations along transportation routes.

Only a severe accident that resulted in a considerable release of radioactive material could cause high and adverse impacts in the affected populations. Because the risk of these accidents applies to the entire population along transportation routes, it would not apply disproportionately to any minority or low-income populations along the routes.

Additional information concerning the assessment of transportation impacts is provided in Appendix D.

**Offsite Activities.** The potential that low-income or minority populations could experience disproportionately high and adverse environmental consequences at sites where waste management activities would occur was addressed in earlier NEPA documents (see Section 1.7.1). No such potential impacts were identified for any site. For LLW, mixed LLW, and HLW, the potential for adverse human health impacts as a result of waste management activities is low, and no disproportionately high and adverse health effects would be expected for any particular segment of the population, including low-income or minority populations.

With respect to TRU waste, the WM PEIS concluded that the potential for disproportionately high and adverse human health effects as a result of TRU waste treatment operations was low for all sites except INEEL and WIPP (WM PEIS, Section 8.10.1). At those sites, the maximally exposed individual member of the public would be located in a census tract that contained a low-income or minority population. WVDP TRU waste, however, would be stored on these sites on an interim basis and would not be treated. Therefore, DOE does not anticipate that the interim storage of WVDP TRU waste at either of these sites would pose disproportionately high and adverse impacts on low-income or minority populations.

## 4.7 REFERENCES

- CEQ (Council on Environmental Quality), 1997. *Guidance for Considering Environmental Justice Under the National Environmental Policy Act*, December 10.
- DOE (U.S. Department of Energy), 1982. *Final Environmental Impact Statement, Long-Term Management of Liquid High-level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley*, DOE/EIS-0081, Washington, DC, June.
- DOE (U.S. Department of Energy), 2000a. *Draft Technical Standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, Washington, DC.
- DOE (U.S. Department of Energy), 2000b. *Draft Guidance on Incorporating Environmental Justice Considerations into the Department of Energy's National Environmental Policy Act Process*, April.
- EPA (U.S. Environmental Protection Agency), 1997. *Exposure Factors Handbook, Volume II, Food Ingestion Factors*, Report No. EPA/600/P-95/002Fb, Washington, DC.
- ICRP (International Commission on Radiological Protection), 1991. *1990 Recommendations of the International Commission on Radiological Protection*. ICRP Publication 60. Elmsford, NY: Pergamon Press, Annals of the ICRP; 21(1-3).

- Johnson, P.E. and R.D. Michelhaugh, 2000. *Transportation Routing Analysis Geographic Information System (WebTRAGIS) User's Manual*. Oak Ridge, TN: Oak Ridge National Laboratory; Report No. ORNL/TM-2000/86.
- Napier et al. (B.A. Napier, R.A. Peloquin, D.L. Strenge, and J.V. Ramsdell), 1988. GENII: The Hanford Environmental Radiation Dosimetry Software System, Volumes 1 and 2, Report No. PNL-6584, Pacific Northwest Laboratory: Richland, WA.
- Neuhauser et al. (K.S. Neuhauser, F.L. Kanipe, and R.F. Weiner,) 2000. *RADTRAN 5 Technical Manual*, Albuquerque, NM: Sandia National Laboratories; Report No. SAND2000-1256.
- U.S. Bureau of the Census, 1997. *Statistical Abstract of the United States: 1997* (117th Edition), Washington, DC.
- WVNS (West Valley Nuclear Services Company), 1996. *West Valley Demonstration Project Site Environmental Report Calendar Year 1995*, U.S. Department of Energy: West Valley, NY. June.
- WVNS (West Valley Nuclear Services Company), 1997. *West Valley Demonstration Project Site Environmental Report Calendar Year 1996*, U.S. Department of Energy: West Valley, NY. June.
- WVNS (West Valley Nuclear Services Company), 1998. *West Valley Demonstration Project Site Environmental Report Calendar Year 1997*, U.S. Department of Energy: West Valley, NY. June.
- WVNS (West Valley Nuclear Services Company), 1999. *West Valley Demonstration Project Site Environmental Report Calendar Year 1998*, U.S. Department of Energy: West Valley, NY. June.
- WVNS (West Valley Nuclear Services Company), 2000a. *Manual for Radiological Assessment of Environmental Releases at the WVDP*, Report No. WVDP-065, Revision 3. West Valley Nuclear Services Company: West Valley, NY. August.
- WVNS (West Valley Nuclear Services Company), 2000b. *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage*, Report No. WVNS-SAR-003, Revision 8, West Valley Nuclear Services Company, West Valley, NY.
- WVNS (West Valley Nuclear Services Company), 2000c. *West Valley Demonstration Project Site Environmental Report Calendar Year 1999*, U.S. Department of Energy: West Valley, NY, June.
- WVNS (West Valley Nuclear Services Company), 2001. *WVDP Radiological Controls Manual*, Report No. WVDP-010. U.S. Department of Energy: West Valley, NY. August.
- Yuan et al. (Y.C. Yuan, S.Y. Chen, B. Biwer, and D.J. LePoire), 1995. *RISKIND- A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, Argonne National Laboratory; Report No. ANL/EAD-1, Argonne, IL.